Illum. - Tinker p. 198

Vol. 15, No. 6

RICHARD FEINBERG

JUNE, 1938

The AMERICAN JOURNAL of OPTOMETRY

EDITORS

CAREL C. KOCH JACK I. KURTZ

COLLABORATORS

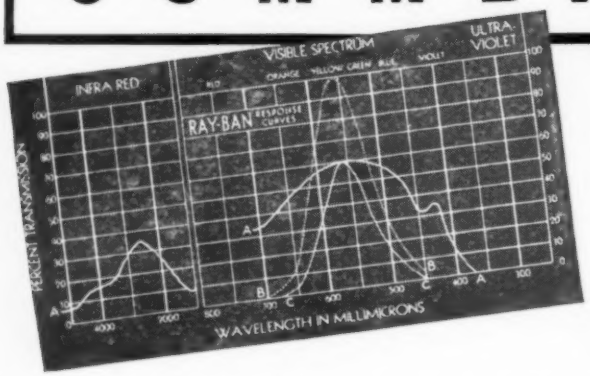
RALPH M. ABEL, *St. Louis, Mo.*
EARL ALLGAIER, *Ames, Iowa*
J. FRED ANDREAE, *Baltimore, Md.*
J. O. BAXTER, JR., *Fayetteville, N. C.*
J. O. BAXTER, SR., *New Bern, N. C.*
L. L. BEACHER, *New York, N. Y.*
ROBERT J. BEITEL, JR., *Southbridge, Mass.*
ROBT. T. BEST, *Fairmont, Minn.*
W. I. BROWN, *New Bedford, Mass.*
J. T. CAMPBELL, *Washington, N. C.*
BRANT CLARK, *San Jose, Calif.*
J. ROBINSON COHEN, *New York, N. Y.*
HOWARD C. DOANE, *Boston, Mass.*
J. H. DRAKEFORD, *New York, N. Y.*
G. L. DUPLESSIS, *Minneapolis, Minn.*
ISRAEL DVORINE, *Baltimore, Md.*
T. H. EAMES, *West Somerville, Mass.*
WM. FEINBLOOM, *New York, N. Y.*
L. P. FOLSOM, *South Royalton, Vt.*
HARRY LEE FORDING, *Portland, Ore.*
W. H. GLAZER, *Philadelphia, Pa.*
J. G. GOODSELL, *Los Angeles, Calif.*
NELSON GREEMAN, *San Antonio, Texas*
HARRIS GRUMAN, *Lebanon, Pa.*
R. M. HALL, *Cleveland, Ohio*
C. J. HATHAWAY, *Pontiac, Mich.*
C. K. HAYNES, *Jamestown, N. Y.*
NORMAN B. HAYS, *Niagara Falls, N. Y.*
W. JEROME HEATHER, *Chicago, Ill.*
ARTHUR E. HOARE, *Los Angeles, Cal.*
H. S. HORTON, *Cleveland, Ohio*
E. E. HOTALING, *New York, N. Y.*
J. F. HURWITZ, *New York, N. Y.*
E. A. HUTCHINSON, *Los Angeles, Cal.*
CHARLES E. JAECKLE, *Newark, N. J.*
H. D. JUDD, *Detroit, Mich.*
L. H. KRASKIN, *Washington, D. C.*
ALVHH H. LAUER, *Ames, Iowa*
C. V. LYONS, *San Francisco, Calif.*
G. A. MACELREE, JR., *Philadelphia, Pa.*
F. L. MASON, *Berkley, Calif.*
D. J. MAYER, *Riverside, Calif.*
O. L. MCCULLOCH, *Holyoke, Mass.*
F. MCFADDEN, *Rutland, Vt.*
O. J. MELVIN, *Omaha, Nebr.*
WILLIAM B. NEEDLES, *Chicago, Ill.*
JOHN C. NEILL, *Philadelphia, Pa.*
J. F. NEUMUELLER, *Southbridge, Mass.*
G. O. OHLSSON, *Detroit, Mich.*
C. R. PADELFORD, *Fall River, Mass.*
D. R. PAINE, *Topeka, Kansas*
GEO. A. PARKINS, *Ord, Nebr.*
R. J. PEARCE, *Greensboro, N. C.*
HERBERT S. PLAYER, *Stockton, Calif.*
RAY MORSE-PECKHAM, *Detroit, Mich.*
ERNEST PETRY, *Rochester, N. Y.*
HARRY E. PINE, *Chicago, Ill.*
A. R. REINEKE, *Oakland, Calif.*
S. M. ROBINSON, *Prescott, Ariz.*
E. LEROY RYER, *New York, N. Y.*
H. LESLIE SALOV, *Newark, N. J.*
Z. J. SCHOEN, *University, Virginia*
CHARLES SHEARD, *Rochester, Minn.*
CARL SHEPHARD, *Chicago, Ill.*
R. E. SIMPSON, *Pasedena, Calif.*
WILLIAM SMITH, *Roxbury, Mass.*
H. RILEY SPITLER, *Eaton, Ohio*
M. STEINFELD, *Paducah, Ky.*
EDWIN F. TAIT, *Philadelphia, Pa.*
WILLIAM J. TAIT, *Philadelphia, Pa.*
R. N. WALKER, *Winston-Salem, N. C.*
A. D. WHEELOCK, *Des Moines, Iowa*
A. WHITAKER, JR., *Bridgetown, N. J.*
E. G. WISEMAN, *Buffalo, N. Y.*
ARENE T. WRAY, *Los Angeles, Calif.*
N. A. ZEVIN, *Philadelphia, Pa.*

Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1501 Foshay Tower, 821 Marquette Ave., Minneapolis, Minn.

ANNUAL SUBSCRIPTION $4.00. CANADA $4.50, FOREIGN $5.00
Single copies, 50c.

Entered as second-class matter February 20, 1924, at the postoffice at Minneapolis, Minnesota, under the Act of March 3, 1879.

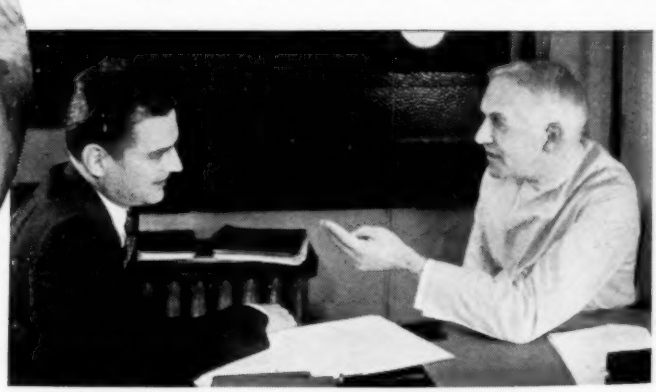
SUMMER



Developed to meet U. S. Army and Navy specifications, Bausch & Lomb Ray-Ban Anti-Glare Lenses were last month made available to the public in two new smartly streamlined styles and a "hook-over" type sun glass. Chart above shows how Ray-Ban transmission curve closely approaches visibility curve of the eye thereby making it the ideal out-of-doors glass.

America's foremost glasses for out-of-door wear are the new Ray-Bans. Available in two sizes of Pink Crystal or Demi Blond Zylonite; in two sizes of 1/10 12K golf-filled frames and in three sizes of the "hook-over" style. Ray-Ban Lenses are optically ground and polished by Bausch & Lomb or made to individual prescription by your convenient Riggs laboratory.

Year in and year out the neutral transmission of Soft-Lite absorptive glass makes Soft-Lite Lenses the most satisfactory ophthalmic lens to prescribe for those whose eyes need slightly more protection from overbrightness than that provided by ordinary white glass. For everyday wear—for improved appearance prescribe Soft-Lite; for out-of-doors protection recommend Ray-Ban—both manufactured by B&L.



Refractionists the world over agree there is no substitute for the satisfaction which comes from Bausch & Lomb quality products. Prescribe them for your patients via Riggs Rx service and you enjoy the double satisfaction of knowing that your Rx is filled accurately and that the products used are what you ordered. Riggs policy of enclosing the original lens envelopes with every corrected lens or first quality toric Rx is your protection. Learn the satisfaction of Riggs service.

RIGGS OPTICAL COMPANY, ***Distributors of Bausch & Lomb Products***

AMERICAN JOURNAL OF OPTOMETRY

Vol. 15 JUNE, 1938 No. 6

CONTENTS

ORIGINAL PAPERS

Illumination Standards for Efficient Work in the Home, Office and Factory. Miles A Tinker 198

A Discussion of Telescopic Spectacles and Their Use. Augustus N. Abbott 208

A New Type of Absorption Glass. G. L. DuPlessis 214

The Use of Binocular Additions for Exotropes: A Case Report. Deryck Humphries 222

Some of the Teachings of the Optometric Extension Program Questioned. James O. Baxter, Jr. 224

EDITORIALS

Notes on Orthoptic Treatment Work. J. I. Kurtz 227

SPECIAL REPORTS

The Eye, the Work and Lighting: A Visual Triangle. A. S. Lidiard 232

BOOK NOTICES

An Introduction to Clinical Perimetry. H. M. Traquair 235

Psychological Optics. V. W. Grant 236

The First And Only All Purpose Instrument

An Instrument for Universal Stimulation, Diagnosis, and Treatment for all imbalances of the Fusion Functions, Squint Heterophorias.

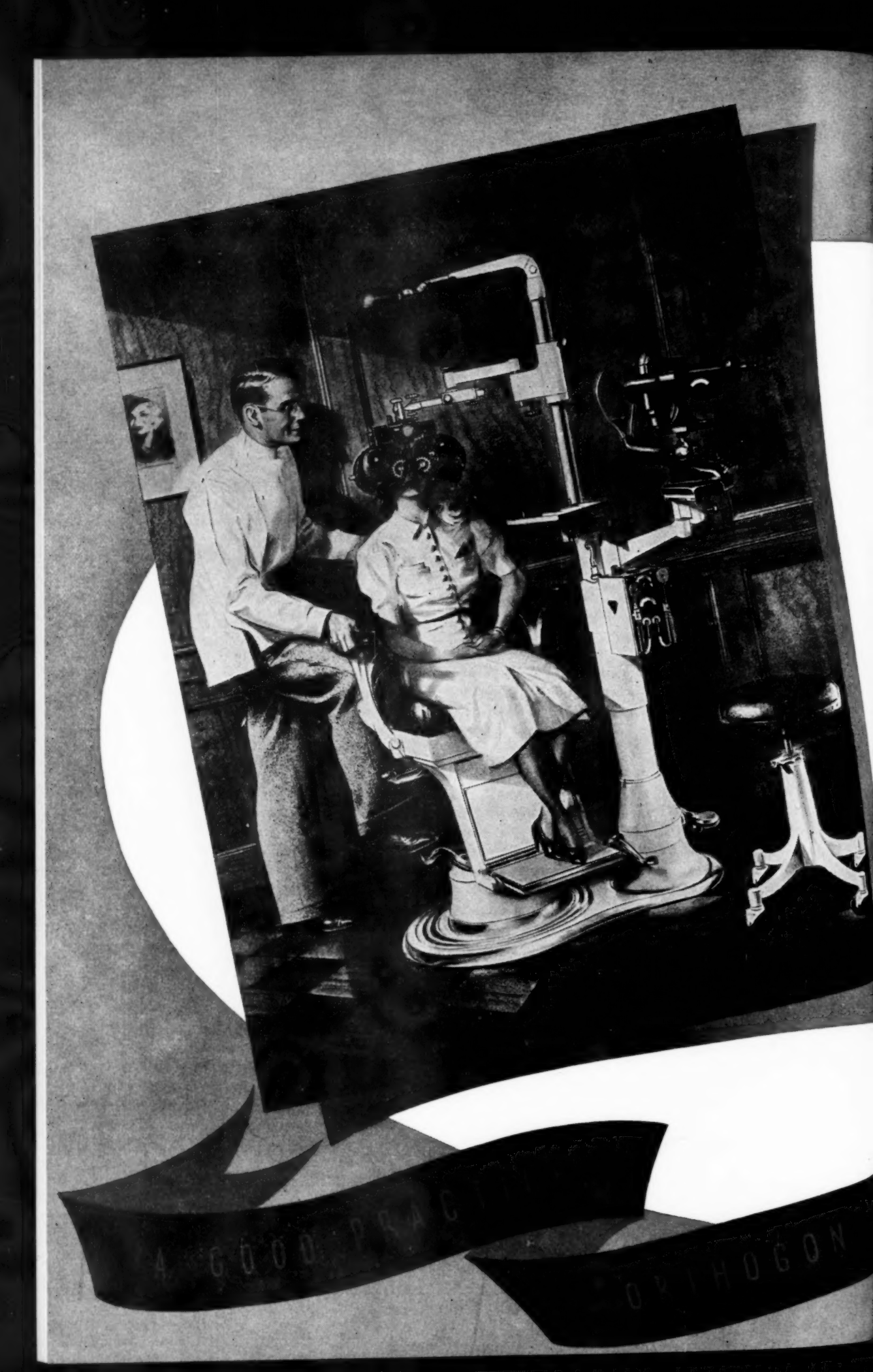
An Instrument unsurpassed for relaxing the extra-ocular muscles and for making all errors of refraction menifest in problem cases.

First of Its Kind In History — Now avaible to the Profession.

Two Weeks Receptionist Training or Special Four Day Clinical Course. Each $50. Discount with purchase of equipment.

THE ARNESON VISUPATHIC RESEARCH EYE CLINIC

Ninth at Nicollet Avenue **Minneapolis, Minnesota**


A GOOD
ORTHOGON

AMERICAN JOURNAL OF OPTOMETRY

Vol. 15 JUNE, 1938 No. 6

ILLUMINATION STANDARDS FOR EFFICIENT WORK IN THE HOME, SCHOOL, OFFICE AND FACTORY*

Miles A. Tinker, Ph.D.
University of Minnesota
Minneapolis, Minn.

Emphasis upon hygienic illumination has become more and more prominent during the past three years. It may well be said that recent events have produced a lighting consciousness. This is due to information from many sources. These include the better light—better sight publicity, articles in newspapers and popular magazines by writers who have interviewed lighting experts, reports written by educators for educational magazines, and popular articles by medical men printed in popular and scientific medical journals. In addition a number of experimental reports have appeared in the psychological and engineering journals and in pamphlet form (publications from His Majesty's Stationery Office). These all reflect a keen interest in illumination and a sincere desire on the part of the public for sound information concerning hygienic lighting.

Every survey of lighting that has been made reveals inadequate illumination in a large majority of homes, offices, schools and factories. Apparently lighting arrangements have been prescribed without satisfactory planning by competent persons. Frequently the lighting is either too dim or is arranged so that uncomfortable glare is present. Such conditions are no longer excusable since the information now available from the research of engineers, physiologists and psychologists furnishes a sound basis for satisfactory lighting practice. Conscientious application of the relatively few basic principles of hygienic illumination will provide healthy conditions for visual work of all kinds without excessive increase in cost or sacrifice of beauty.

Three aspects of lighting are quality or color, brightness or intensity, and distribution or diffusion. Color of light as such has little effect upon efficiency and comfort of vision. Where extremely fine discrimination is required, however, yellow light is slightly superior to other colors. Sunlight (white light composed of all colors of the spectrum) is superior

*Submitted for publication May 9, 1938.

to any artificial light. In practical situations, such as reading, office work, and factory operations, artificial light derived from ordinary commercial bulbs is just as effective as illumination from sodium vapor lamps (yellow), mercury arc lamps or daylight bulbs. In general one may employ whatever color he wishes for special effects and still maintain hygienic lighting providing other factors are controlled.

Two factors of high importance are intensity and distribution of light. These are intimately related and therefore, should be coordinated with each other. We shall discuss intensity first and then show how it must be coordinated with distribution.

Intensity of light is measured in foot-candles. One foot-candle is the brightness of light from a standard candle one foot away. Light meters are now available for quick and accurate measurement of brightness level. (Such instruments should be calibrated frequently since they tend to become inaccurate with use and to register less than the true values). Most readers will not have a light meter available. Table 1 will give some notion of the relative brightness of different sizes of light bulbs. The intensities cited were measured with a recently calibrated General Electric Light Meter for frosted Mazda bulbs in an ordinary bridge lamp with a 12-inch circular gray parchment shade. Read the table as follows: a 25-watt bulb yields 10 foot-candles at a distance of 16 inches, 15 foot-

TABLE 1

Relative intensities of light from different sized frosted bulbs

Watt size	Distance in inches between bulb and working surface to get designated intensities		
	10 foot-candles	15 foot-candles	25 foot-candles
25	16	12	9
40	23	19	14
50	27	21	17
60	31	26	20
75	49	40	31
100	52	44	34

candles at 12 inches, and 25 foot-candles at 9 inches. These distances should be employed only as approximations of course, since bulbs and lamp shades vary somewhat and the brightness of any bulb decreases with use.

There is general agreement among many investigators concerning the relation of illumination intensity to visual acuity. Experiments to determine this relationship have required visual discrimination of very fine detail under various intensities of light [15]. The typical findings follow: Progressing from low to high intensities, there is a rapid rise in visual acuity up to about 5 foot-candles. With further increases in intensity levels the corresponding rise in acuity becomes slower and slower

and almost reaches a maximum at about 20 foot-candles. In fact, improvement in acuity from about 15 foot-candles to higher levels is scarcely noticeable. These trends are well illustrated by the following results: There was found a 67.7 per cent increase in acuity from 0.1 to 1.0 foot-candle, a 43.6 per cent increase from 1.0 to 5.0 foot-candles and a mere 8.2 per cent increase from 5.0 to 20.0 foot-candles. From 20 to 100 foot-candles the increase in acuity is slight.

Everyday life situations seldom require the exacting discrimination demanded in visual acuity tests. Results from acuity measurement cannot, therefore, be applied to most ordinary working situations. Investigations of a different kind are needed. Several of these studies are summarized in Table 2. This table shows the intensity of light beyond which (brighter illumination) there is no further gain in efficiency of

TABLE 2.

Brightness of illumination beyond which no gain in visual efficiency occurs with further increase in intensity

Operation (with source indicated)	Foot-Candles
Reading 10-point type [16]	3
Reading [18]	4
Reading 12-point type [11]	Between 1 and 10
Reading performance in school [2]	4 to 6
Educational achievement in school [2]	4 to 6
Doing arithmetic [4]	Less than 9.6
Sorting mail [20]	8 to 10
Setting 6-point type by hand [19]	Between 13 and 25
Time to thread a needle [18]	30

performance. For the first item in Table 2, intensities from 0.1 to 53 foot-candles were employed. The performance was the same at 10, 17, and 53 foot-candles as at 3 foot-candles. When the measurement was in terms of fatigue induced by reading two consecutive hours under each intensity, a complete check was obtained. There was no less fatigue for working under the brighter lights than for 3 foot-candles. The 4 foot-candles, obtained by another investigator (item 2) is close to the results in the first study, i e., 3 foot-candles. In the third study cited, reading was done under 1, 10 and 100 foot-candles. There was improvement from 1 to 10, but no significant gain from the 10 to 100 foot-candles. In the next two items, reading and educational progress in school was measured under 4 to 6 foot-candles and under 20 foot-candles. There were no significant differences from one intensity to the other when computations are corrected. As shown in the next item, performance in doing arithmetic problems under light varying from 9.6 to 118 foot-candles failed to show any differential achievement. In the next experiment, letter sorting by postoffice employees reached its maximum speed only when the illumination was at least 8 foot-candles. The increase in efficiency was rapid from 2 to 5 foot-candles, and only slight

from 5 to 8 or 10. Efficiency of setting 6 point (small) type by hand was measured under intensities varying from 1.3 to 24.5 foot-candles. Maximum performance (same as in daylight) was found to come somewhere between 13.0 and 24.5 foot-candles. The time to thread a needle was shortest only when the light was about 30 foot-candles.

For ordinary reading of 10 to 12 point type (like most book type) the critical level of brightness beyond which no improvement in efficiency occurs and beyond which fatigue does not decrease appears to fall between 3 and 4 foot-candles. This finding is indicated directly or may be inferred from the first six citations in Table 2. In a somewhat more exacting visual task than ordinary reading (sorting mail), the critical level falls between 8 and 10 foot-candles. With very exacting visual tasks the critical level apparently falls between 20 and 30 foot-candles.

Beutell,[5] taking account of size of detail, contrast and emphasis on details finds that intensities for efficient performance are 6 foot-candles for clerical work, 12.0 foot-candles for mechanical drawing and 24 foot-candles for setting 6 point type.

In recent studies, Ferree and Rand[7,9] have demonstrated that presbyopic eyes can benefit by relatively high illumination intensities. The same is true for reading illegible print.[8,16]

What appear to be extremely high intensities have been recommended by Luckiesh and Moss[11,12,13] for visual tasks. For instance they suggest 20 to 50 foot-candles for ordinary reading and 50 to 100 foot-candles for difficult reading and average sewing. Tinker[17] has shown that the experimental data from which these recommendations were derived have been misinterpreted. Their data actually show that no significant changes occur in their measurements when the intensity of light is raised above about 10 to 15 foot-candles. Practically all popular articles which have appeared in magazines, newspapers and educational journals have accepted the Luckiesh and Moss recommendations. Since the experimental basis for these recommendations is unsound all the suggestions on intensities in the popular articles are also invalid.

The American Recommended Practice of School Lighting[3] approved February 17, 1938, suggest 15 foot-candles as the minimum intensity at the desks and tables. There seems to be two sources from which these recommendations are derived. The first source is apparently the work of Luckiesh and Moss. As indicated above, their data have been misinterpreted. Dates[6] says that the new recommended practice is based partly upon Allphin's[2] findings. In his experiment various measures of school progress were made on children in two school rooms. In one room the intensity of light was 4 to 6 foot-candles; in the other it was maintained with a minimum level of 20 foot-candles. Measurements of achievement were made in November and in June. The author claims that the pupils in the room with 20 foot-candles gained 10 per cent in

educational age over the pupils in the 4 to 6 foot-candle room. The comparable differences for gain in reading achievement is stated to be 28 per cent. Examination of the data show a *gross error in computation of the percentages.* Pertinent data with percentages computed correctly are given in Table 3. All scores are in terms of months. The data show that

TABLE 3

Influence of School Lighting on Scholarship

(From Allphin,[2])

N=41 fifth grade children in each room

Measure	20 Foot-candles	4 to 6 Foot-candles
November School Achievement	118.34	118.27
June School Achievement	129.83	128.76
Gain*	11.49 (9.7%)	10.49 (8.9%)
November Reading	121.61	121.10
June Reading	132.76	130.17
Gain*	11.15 (9.1%)	9.07 (7.5%)

**Difference in percentage gain*: School achievement, 0.8 of one per cent; reading, 1.6 per cent. These are little better than chance since the ratio of the difference to the probable error of the difference is only 0.58 for the former and 0.84 for the latter.

pupils in the 20 foot-candle room gained 9.7 per cent, and those in the 4 to 6 foot-candle room gained 8.9 per cent. The difference in gain is 0.8 of one per cent. Statistical evaluation shows this to be a chance difference, i. e., that it is apt to be in favor of the other group if the experiment were repeated. Similarly, the table reveals the difference in gain for reading achievement to be 1.6 per cent. This also is a chance difference. The only conclusion justified by the data is that the achievement in the 20 foot-candle room was equal to that in the 4 to 6 foot-candle room, i. e., the difference in brightness of illumination had no effect upon school achievement. It is obvious that Allphin did not compute the percentage difference in amount of gain for achievement in the two rooms but merely obtained the difference between the two gains (11.49-10.49 and 11.15-9.07) and turned this into percentage employing the smaller gain as the base from which to compute the per cent. Such a result is obviously meaningless and has no significant bearing on the question of how much the pupils in one room gained from November to June in comparison to the pupils in the other room. The absurdity of computing percentages in this way is shown by an example: Suppose the pupils in the 20 foot-candle room had gained 1.0 month in reading achievement and in the 4-6 foot-candle room 0.5 month. Then, by Allphin's method (0.5 as the base from which to compute the percentage) the pupils in the brightly illuminated room would show a 100 per cent greater gain. The only statistically acceptable method is to turn each gain from November to June into per cent and then compare one room with the other as indicated in Table 3.

It is interesting to note that the National Council on Schoolhouse construction is withholding approval of the 15 foot-candle recommen-

dation (see above) until further scientific tests have been made. More in line with experimental results is the recommendation of the International Commission on Illumination, which suggests that the minimum intensity of light in school rooms be set at 8 foot-candles (Sight-Saving Review, December, 1935, p. 302). Thus we see that the American Recommended Practice of School Lighting seems to be based entirely upon conclusions derived from misinterpreted experimental results. It may be that school children need 15 foot-candles of light, but the evidence adduced by Dates[6] in discussing the new recommendations is shown to be without sound experimental foundation.

Intensity of illumination in factories has frequently been found to be woefully low. Frequently industrial lighting seems to have been prescribed without adequate planning.[19] Studies have shown that it is a paying proposition to furnish adequate light. Table 4 shows the effect of increasing intensity of light in certain industries.[18] The averages from

TABLE 4.

Effect of Increasing Intensity of Light in Industry[18]

Factory	Initial Foot-Candle Level	New Foot-Candle Level	Per Cent Increase in Production
Electrical	3.8	11.4	8.5
Piston Ring	1.2	6.5	13.0
" "	1.2	9.0	17.9
" "	1.2	14.0	25.8
Roller Bearing	5.0	6.0	4.0
" "	5.0	13.0	8.0
" "	5.0	20.0	12.5

19 sets of figures[18] reveal a 13.8 per cent increase of production when the original mean intensity of 2.7 foot-candles was raised to 10.9 foot-candles. After a thorough analysis of available data Troland[18] concluded, "The vast majority of industrial operations can be carried out at maximum efficiency with an illumination intensity in the neighborhood of 10 foot-candles." Nevertheless, there are ample data to show that certain special factory operations which require fine visual discrimination, such as inspection of roller bearings, are more efficiently performed with somewhat higher intensities. No experimental results, however, indicate that these tasks involving fine discrimination require more than about 20-25 foot-candles of light. There is some evidence which suggests that efficiency of factory work is greater (about 10 per cent) with daylight illumination than with artificial light.[18]

In rough factory work, such as tile pressing, Adams[1] has shown that an intensity of 3 to 4 foot-candles should be employed to assure efficient working conditions. Numerous uncontrolled observations of changes in factory lighting have revealed apparent improvement of production when light intensities were increased.

The control of light distribution throughout the work room is

perhaps more important than the factor of intensity. To insure optimal hygienic illumination there must be an adequate balancing of these two factors. Failure to maintain a satisfactory dispersion of light in the visual field frequently results in lessened visual efficiency and eyestrain. This occurs in the presence of glare arising from poor arrangement and type of lighting fixtures, from surface reflection and from variation of bright spots and shadows in the visual field.

All have experienced the disagreeable effects of bright spots of light above or off to the side of the line of vision while reading, doing other visual work, or even when no visual discrimination is taking place. Peripheral illumination of this type is a disturbing factor of high importance. As these side lights become brighter or are moved closer to the line of direct vision (the immediate working surface) their fatiguing effects become greater. Furthermore, the greater number of peripheral light sources there are, the more detrimental is their effect on vision. Continuous visual work under these conditions, therefore, is unhygienic. The resulting fatigue is apparently due to muscular strain rather than to retinal fatigue. When the peripheral portions of the retina are stimulated there is a reflex tendency to fixate the stimulating source. To maintain constant fixation on the working surface requires constant activity of antagonistic muscles. The eyestrain produced in this manner is soon manifested in fatigue and loss of efficiency.

Highly polished or glazed objects in the field of view produce reflected light which also leads to uncomfortable glare and loss of visual efficiency. Nickel plated metal (parts of a typewriter) and glazed printing paper are examples of such surfaces. The more uniformly the light is diffused throughout the work room, however, the less there is of this kind of glare.

Brightness contrast within that position of the visual field where critical vision is required and also in the immediate surroundings also produces fatigue and lessens efficiency. When the eyes are required to shift back and forth from bright to dark areas or there is a sharp division between dark and bright areas of the working area, the eyes must constantly readapt to the different degrees of brightness. This soon produces eyestrain. If the demarkation between the light and dark areas is sharp, the fatigue effects are increased. This condition is illustrated by white paper on a dark desk, or a dark under-surface of an opaque eye shade used in a brightly illuminated room.

Certain general rules may be formulated to eliminate glare effects. (1) Avoid peripheral spots of light, such as wall brackets and hanging fixtures that reach down into the field of vision. Ceiling fixtures should be at such a height that no spot of light is in the field of view during visual work. (2) Avoid as much as possible the use of glazed paper, polished metallic objects and marked contrasts of brightness within the visual field. (3) Avoid strictly local lighting like that produced by

a desk lamp with an opaque shade. This produces a bright circle of light surrounded by dimly illuminated areas and by shadows. (4) In general, maintain as equal a distribution of light as possible within the area where the visual work is being done.

The proper intensity of light with satisfactory diffusion is most economically obtained through a combination of moderately bright general illumination plus local lighting at the place of work. This is usually achieved by ceiling fixtures supplemented by auxiliary units at the work bench in the factory, and by desk or floor lamps in the office and home. There has recently been developed a single lighting fixture that yields both general and local illumination. This is the I. E. S. (Illuminating Engineering Society) certified lamp. There are both floor and table models. The top of the lamp shade is open so that some light is sent directly to the ceiling where it is reflected about the room in a fairly uniform manner. Below the light bulbs there is a translucent bowl through which the light passes in a diffused manner to the working surface. These lamps, therefore, furnish a highly satisfactory combination of indirect and diffused semidirect illumination. One may use bulbs of smaller wattage than specified for the lamp for many of the ordinary visual tasks. Any table lamp should have the bottom of the shade about 20 inches above the table top. This insures that the light source will be out of the field of vision while working at the table. Likewise, floor lamps should have fairly tall standards. Both floor and table lamps should be to the side or behind the worker. Then the worker will not have to look at the light source even when the eyes are raised.

It is hazardous to recommend intensities of light for general use since many factors, (such as distribution of light, condition of the eye, size of detail to be discriminated, etc.) are involved in determining hygienic lighting. Nevertheless, some specifications may be made that should provide a margin of safety for many ordinary visual tasks. One probably should never read with less than five foot-candles intensity unless the distribution of light is very poor, such as with a bare bulb within the field of view where the visual work is taking place. In such a situation a slightly dimmer light will be less fatiguing. With only fair diffusion of light, use between 5 and 10 foot-candles. If the distribution of illumination is good, use 10 to 15 foot-candles. If no glare due to poor distribution of the light, or to other factors is present, higher intensities may be employed with safety but without gain in efficiency and comfort. In school rooms the minimum level of intensities at the desks should probably not be less than 10 foot-candles. These intensities should assure hygienic vision in most situations since the critical level for reading is between 3 and 4 foot-candles and few instances have appeared where efficiency and comfort have improved by raising the intensity above 10 foot-candles.

There are situations, however, where higher intensities are required to maintain hygienic vision. When eyes are defective, where legibility

is poor, or when extra fine discrimination is required, brighter light is indicated. In these situations the intensity should probably be between 20 and 30 foot-candles.

In industry adequate lighting is a paying proposition. The indications are that most factory operations can be done with comfort and with maximum efficiency under 10 foot-candles of light. Operations requiring fine discrimination need relatively bright light. This intensity, however, probably need not be greater than about 25 foot-candles.

It may be emphasized in closing, that application of the principles here discussed will maintain hygienic illumination that yields efficient performance without eyestrain.

DR. MILES A. TINKER
DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF MINNESOTA
MINNEAPOLIS, MINN.

REFERENCES

1. Adams, S. The Effect of Lighting on Efficiency in Rough Work (tile pressing). London, His Majesty's Stationery Office, 1935.

2. Allphin, W. Influence of School Lighting on Scholarship. Trans. I. E. S., 1936, 31, 739-745.

3. American Recommended Practice of School Lighting. Prepared under joint sponsorship of Illuminating Engineering Society and American Institute of Architects. Washington, 1938.

4. Atkins, E. W. The Efficiency of the Eye Under Different Intensities of Illumination. J. Comp. Psychol., 1927, 1, 1-37.

5. Beuttell, A. W. An Analytical Basis for a Lighting Code. Illum. Eng. (English), 1934, 27, 5-11.

6. Dates, H. B. New Recommendations on School Lighting, for Easier Seeing Based on Research. Industrial Standardization, 1938, 9, 49-54.

7. Feree, C. E., and Rand, G. The Effect of Intensity of Illumination on the Near Point of Vision and a Comparison of the Effect for Presbyopic and Non-presbyopic Eyes. Trans. I. E. S., 1933, 28, 590-611.

8. Feree, C. E., and Rand, G. The Ocular Principles in Lighting Trans. I. E. S., 1925, 20, 270-295.

9. Feree, C. E., Rand, G., and Lewis, E. F. The Effect of Increase of Intensity of Light on the Visual Acuity of Presbyopic and Non-presbyopic Eyes. Trans. I. E S., 1934, 29, 293-313.

10. Koepke, C. A. A Job Analysis of Manufacturing Plants in Minnesota. Minneapolis, University of Minnesota Press, 1934.

11. Luckiesh, M., and Moss, F. K. A Correlation Between Illumination Intensity and Nervous Muscular Tension Resulting from Visual Effort. J. Exper. Psychol., 1933, 16, 540-555.

12. Luckiesh, M., and Moss, F. K. The Science of Seeing. New York, D. Van Nostrand Co., 1937.

13. Luckiesh, M., and Moss, F. K. The New Science of Seeing. Cleveland, Lighting Research Laboratory, General Electric Co., 1934.

14. Luckiesh, M., Taylor, A. H., and Sinden, R. H. Data Pertaining to Visual Discrimination and Desired Illumination Intensities. J. Franklin Inst., 1921, 192, 757-772.

15. Lythgoe, R. J. Illumination and visual capacities. London, His Majesty's Stationery Office, 1926.

16. Tinker, M. A. Illumination and the hygiene of reading. J. Educ. Psychol., 1934, 25, 669-680.

17. Tinker, M. A. Cautions concerning illumination intensities for reading. Amer. J. Optom., 1935, 12, 43-51.

18. Troland, L. T. Analysis of the literature concerning the dependency of visual functions upon illumination intensity. Trans. I.E.S., 1931, 26, 107-196.

19. Weston, H. C., and Taylor, A. K. The relation between illumination and efficiency in fine work (typesetting by hand). London, His Majesty's Stationery Office, 1933.

20. White, L. R., Britten, R. H., Ives, J. E., and Thompson, L. R. Studies in illumination: II. Relation of illumination to ocular efficiency and ocular fatigue among the letter separators in the Chicago Post Office. Public Health Bulletin No. 181, Washington, Gov. Printing Office, 1929.

A DISCUSSION OF TELESCOPIC SPECTACLES AND THEIR USE*

Augustus N. Abbott, Opt.D.
Shawano, Wisconsin

If an explanation were necessary or desirable for the introduction of this subject into the fields of essay, one might plead justification in the well-known fact that there are in the files of every practitioner numerous patients to whom he has been unable to give satisfactory aid by means of the usual ophthalmic correction.

As cause of this difficulty may be numerated ocular or more general pathological backgrounds, direct violence, high refractive errors, myopia and astigmatism, amblyopia, ex-anopsia, and physical or congenital conditions.

Lately telescopic spectacles have received considerable space in the lay press. This publicity was much needed and has brought many prospective patients to our offices seeking information regarding telescopes for the near-blind. In general these people do not seem to realize that the devices are not revolutionary but have been available for many years.

The Zeiss Company produced a telescopic lens as early as 1909. But so far as I know, Dr. Feinbloom of New York must be given full credit for the improvement or development that has been added to the original Zeiss spectacle. There may be others but I am not familiar with their work.

At the present time there are three mechanical methods for aiding victims of very low visual acuity. They are: the telescopic spectacles, the pin hole spectacles, and the contact lens. Each is peculiarly adapted to a peculiar condition.

The telescope is best suited for cases of amblyopia, retinal involvement and high myopia. (Cases not deriving satisfactory results from the myo-disc.) The pin-hole is best for cases of medio-involvement and acute photophobia. The contact lens of course can be used to advantage by any spectacle wearer. The cases of cornea involvement, such as scar-tissue, burns, traumatism, irregularities and conical cornea can only be alleviated with this type of lens.

We intend here only to discuss the application and use of telescopes.

*Submitted for publication May 26, 1938.

All present day telescopic instruments are built on the principle of the early Galilean telescopes or a slight variation thereof.

These scopes consist of a plus objective or converging lens made of crown glass, behind which can be found an air space of several mm. The ocular lens is next in order, being constructed of a flint crown combination producing achromatism.

Those who are familiar with the Zeiss telescopic trial set realize it is a most elaborate combination, consisting of several basic lenses located in the center of the case surrounded by auxiliary lenses. The cylinders ranging from plus to minus 6D. and a variety of spherical elements.

The procedure when using this equipment is to secure the basic prescription with a conventional trial set. Then by combining the auxiliary spheres and cylinders to the large basic lens most nearly matching the original prescription, we endeavor to duplicate the power into telescopic form.

One of the major criticisms of this set is the time that must be consumed in the assembling process, thus making lens changes very slow. As in all cases of refraction, speedy changes are most advisable, making contrast more discernible. Nevertheless, unusually satisfactory results have been obtained with these appliances. The Zeiss scope furnishes magnification of 1.8.

These Zeiss scopes can be used for reading and viewing of distant objects but it is impossible for the wearer to move about for reasons which will be discussed later on.

Dr. Harry Eggers has developed a very simple and satisfactory telescope that can be made up by any competent optician. We require but two strong frames and two pieces of bar metal. Enlarge the joints of the first frame so as to carry two temples, one to be pointed to the fore, 9.2 mm. in length. To these attach a 42 mm. frame front. In the original frame place a minus 10. sphere and in the forward frame a plus 5. You now have a plus 5D objective lens in conjunction with a minus 10D. ocular. The combination can be varied providing the same ratics are maintained. This will produce a clear distant vision giving a magnification of 2. If your patient is not an emmetrope, you must combine your basic prescription with the ocular lens. For example, we will assume best vision is obtained with the following:

OD, plus 1.00 minus .50x90, OS, Plus 2.00 minus .75x90. You must now write your ocular prescription as OD minus 9.00 minus .50x 90, OS minus 8.00 minus .75x90. If the patient is to read with this spectacle, reading additions must be made up in slipovers, using an add from plus 4.00 to plus 10.00. These are to be attached to the objective lens for all near-point work. I would advise that you specify jumbo pads for the nose must carry a considerable load.

This brings us down to a work of Dr. Feinbloom who has contributed five major improvements to the field. The 1.7 spherical scope,

which increases the visual angle over the Zeiss; the powerful 2.2 spherical scope, the cylindrical scope; the microscopic spectacle, and the compound reading attachments to be used with the 2.2.

The Feinbloom scope differs considerably from the Zeiss in that he places the telescopic handicaps in different order than Zeiss and attempts to correct accordingly.

Zeiss aims to reduce distortion, astigmatism of oblique rays and color aberration while maintaining a magnification of 1.8. Dr. Feinbloom correctly maintains chromatism is of slight concern, for most patients have so low a grade of visual acuity that chromatic aberration causes slight disturbance. Thus he corrects in the following order: coma, spherical aberration and astigmatism with chromatic aberration last and of least concern.

The Feinbloom scopes are placed in Zylonite mounts and are true telescopes for they have no ametropic correction inculcated into their optical system.

The 1.7 X is adaptable to the patient who is capable of getting on with less magnification than the 2.2 would furnish and finds the increased field more desirous. This scope allows a field of approximately 33 degrees. The objective lens is 36 mm. in diameter and the length about 22 mm. The scope is suited for near and far-point vision when used with proper reading additions.

The 2.2 is of the same type as the above, save that the magnification is increased and the field reduced to 22 degrees. The objective lens is 26 mm. in diameter, the overall length being about 26 mm. They serve the same purpose as the 1.7 but with a reversal of effect, that is with increase of magnification and decrease of field.

The cylindrical telescope is the only scope which allows the patient to move about while wearing it. With this device he is free to walk about the streets at will. With acknowledgments to Dr. Feinbloom, I shall attempt to explain the reason for this phenomena.

The lens system was developed by him after a long period of research and experimentation. To anyone familiar with the telescope, field glass or opera glass two phenomenas must have been apparent. First, the fact that the angular size of the image viewed through the instrument is greater than the object of regard by the amount of the magnifying power of the instrument.

The psychological phenomena is that the angular increase in the image size is not interpreted mentally as an increase in the size of the object but as a decrease in the object distance. This exists regardless of the fact that the image plane of the scope is in the same physical plane as the object. If the scope has a magnification of 3, the mind records a reduction of distance to one-third; magnification of 2 to a distance of one-half. This phenomena is termed the telescopic parrallax (TP). The formula to be used for making calculations is TP equals 1 over M. These

phenomena make it impossible to walk about with a spherical scope. Dr. Feinbloom's cylindrical telescope recognizes these two phenomena and applies them to the new device. He has thus evolved this rule, "The meridian will be chosen for monocular or binocular projection whose angular size approaches most nearly that of the absolute dimension of the object."

It was found in the laboratory that so long as the magnifying difference of the two principal meridians does not exceed 50%, there will be no marked difficulty. Using this as a basis they standardized upon the present cylindrical scope, whose vertical meridian has a magnification of 1.3 and the horizontal meridian 1.7. With these scopes the patient judges distance according to the vertical meridian and derives the magnification from the horizontal. Of course the image is distorted but this distortion is acceptable in most cases. Probably for the same reason that high uncorrected astigmatism is often times tolerated without complaint. The vertical field is 37 degrees and the horizontal 45 degrees.

The microscopic spectacle is a powerful reading glass built on the principle of the two-lens microscope rather than that of the Galilean telescope. Two plano-convex lenses are joined together with the convex surfaces inward. They are 32 mm. in diameter and the magnification varies from 8X to 18X.

The compound reading attachments are for use with 2.2 scope as previously stated, providing reading magnification from 6 mm. to 15 mm. The field of reading ranges from 10 to 25 mm.

When dealing with telescopes it is needless to say we confine our examination to monocular procedure omitting all phorias, ductions, etc. It is most important that we secure the full subjective refraction, always producing best vision possible, for the scopes magnify blur circles as well as the objects of regard.

It is advisable to refrain from the use of a refracting instrument such as a phorometer or phoropter. Best results will be obtained from any of the new fully adjustable trial frames which have the individual PD adjustment and the riding bow temples.

Theoretically, one should be able to calculate the visual improvement to be expected from the telescopes, however in actual practice this is not necessarily the case. Assuming the patient has 20-200 or 10% visual acuity, with a conventional correction, we would expect the 2.2 scope to raise the vision to 20-95 or about 23% plus, VA. Not infrequently the improvement is greater than the mathematical calculations would cause one to expect. Drs. Gradle and Steine attribute this to pathology of fovial region. I have not been able to bring myself into line with this view; I am inclined to attribute it to a phychological reaction rather than to a physical condition.

A complete but brief history of the patient should first be taken which will include age, duration of sub-normal vision, changes in the

past six months, two years and five years, previous diagnosis, ability to walk about alone, is vision best at day or night, when last to moving pictures, ability to read headlines, is he wearing glasses for P.P. or P.R. which eye is the better, and ability to recognize colors.

For aligning the trial frame, I find this little trick successful. Take two low-powered cylinders, join the diamond axis markers by a light ink line. Then place the lens in the trial frame with ink mark in the 90 meridian, instruct the patient to look straight ahead, then regulate the P.D. adjustment until the line bisects the pupil. Next, rotate the line to the 180th meridian and correct the elevation until the line again bisects the pupil. The frame should now be perfectly aligned and centered before the eyes. You are now ready to start the refraction, which should include opthalmoscopy, ophthalmometry, retinoscopy, subjective refraction and a field chart. After placing the scopes before the eyes it may be advisable to slightly alter the basic correction, for with the additional magnification his sensitivity to changes will be increased.

The static subjective examination is then followed by a subjective at near-point. Place the reading add in front of the scopes and experiment with powers from 6D upwards. The reading card must be in the exact focal plane of the add being used. Practically all near-point vision is monocular. The binocular near-point telescope is most difficult to adjust because of the necessity of precise lateral angulation in order to secure fusion. This angulation will prevent fusion at infinity and each change of reading addition will require a corresponding change in the angulation of the optical system: inasmuch as most patients require several reading adds, thus making binocular satisfaction all but impossible. Regardless of age, no one is capable of reading at a near point through a telescope without the aid of reading additions, for these instruments kill all accommodative power.

Completion of the mechanical work merely marks the beginning of your task for you must now lead the patient through many hours and weeks of intelligent, sympathetic training. In short, you must practice pedagogy as well as optometry.

Telescopic devices can not be merely ordered and dispensed as an ordinary correction. This practice in the past can be held responsible for much of the discredit attributed to them and is certain to end in dissatisfaction.

The more advanced the age of the patient, the more tedious will be the training period, as would be expected. He must be taught to coordinate brain, head, eyes and hand and the infirmities incidental to a declining virility render this more difficult.

Sub-normal patients present problems in control not encountered in other types of work. The blind and near-blind live in a world peculiarly their own which is foreign to ours. Their emotional reactions are often most difficult to interpret. I believe an experienced practitioner such as

Dr. Feinbloom could write a book, limiting his subject matter to the psychological aspect of these cases.

A common question asked by practitioners is, "What type of case would you consider a feasible prospect for telescopic lenses?" To my mind, a person who finds it impossible to carry on his daily duties and avocations with a standard ophthalmic lens, can be looked upon as a prospective telescopic patient. It is not advisable to apply these instruments before the patient reaches this period for he will not tolerate their inconvenience nor subject himself to the necessary training.

The fitting of telescopic spectacles is truly the work of our profession for it requires the highest degree of refractive skill.

The pathology in a great majority of these cases has either become arrested, run its course, or been cured long before the patient consults the optometrist. He, no doubt, has received all the aid the medical man is capable of offering and has been discharged. *Never attempt to apply sub-normal devices to a case in which the pathology seems to be progressive unless you are working in conjunction with a physician, for this will lead the patient and yourself to grief.*

In conclusion of this brief essay upon this most interesting subject and in answer to a question not infrequently asked of me I would say that the fitting of telescopic lenses is not particularly attractive viewed from the financial angle as the number of patients is obviously limited. But the practitioner who derives pleasure and satisfaction in helping his fellow-man, will find in this field of opportunity a worthwhile endeavor, paying a high reward in personal satisfaction. Because of the comparatively small number of potential patients, the man entering this field must be dependent upon his fellow-practitioners for a good share of his clientele, in the same way that the specialist in the medical field is dependent upon referred patients.

I believe it is the duty of the optometric profession to adequately provide the public with this service. At present it is not being done.

AUGUSTUS N. ABBOTT, OPT.D.
SHAWANO, WIS.

A NEW TYPE OF ABSORPTION GLASS*

G. L. DuPlessis, Opt.D.
Minneapolis, Minn.

At the International Optical Congress held in Cologne in July, 1928 a "report on the latest Ultra-red and Ultra-violet researches on human and animal eyes" was presented by Dr. Walter Mindt, Director of the German School of Optics and Phototechnics of Berlin.

Dr. Mindt[1] states that the idea that certain lights can be injurious to the eyes dates back to the seventeenth century. This idea has since been confirmed in principle, but the nature and extent of injuries is still debatable. He divides researches made on this subject into three groups: The first group, as best exampled by Vogt, isolates groups of rays and observes the resulting injury when animal eyes are exposed to them. Vogt concluded that rays of more than 1500 μ have no penetration whereas the short wave infra-reds between 1500 and 800 μ may cause injuries to even the choroid and retina. He attributes to these latter rays the phenomenon of sun blinding.

Also in the first group is Trümpy who concludes that ultra-violet rays between 435 and 314 μ can cause no injury to the eyes, and that rays below 314 to 253 μ as found in high altitude and in artificial sources of light, such as alpine sun lamp, can only cause superficial injuries to the cornea and conjunctiva. Anyone having experienced actinic conjunctivitis can understand how those injuries while painful are not lasting.

Mindt is emphatic in stating that the result of these studies, while not final has definitely established which end of the spectrum is responsible for deep eye injuries. Unfortunately these experiments were all made on animal eyes and Vogt made no quantitative evaluation of the energy factor in analizing the injurious effect of a bundle of rays.

In the second group of investigators, Kuhl and Weiss have studied injuries of the eyes due to radiation and have arrived at the same conclusion as investigators in other groups, except that the deleterious effects of ultra-violet have been emphasized (injuries frequent, tho superficial). The question remaining in these researches is whether the injuries were

*Submitted for publication, May 1, 1938.

caused by any single ray or by overlapping bundle of rays.

The third group have confined themselves to an evaluation of absorbtion in the various media of the eye. Roggenbau and Wetthauer have determined by physically exact methods that all layers of the eye absorb radiation beginning in the Ultra-violet where this absorbtion is slight, increases as it approaches the infra-red, the lens of the eye for one, absorbing 25 to 30% of the energy between 1000 and 1200 μ, and that the region of the spectrum of greatest intensity reaching the retina is in the infra-red.

Mindt points out that as the greatest energy absorbtion takes place in the inner layers of the eye, greater attention must be paid to the physiologic effects of radiant energy inside of the eye. Mindt concludes with a word of warning against jumping at conclusions on the injurious effect of infra-red rays. True that from a qualitative standpoint all investigations point to infra-red responsibility, but the quantitative problem remains to be cleared up.

If the crystalline lens according to Roggenbau and Wetterhauer, absorbs 25 to 30% of infra-red energy between 1000 and 1200 μ, such rays being of particularly strong intensities in open furnaces, there is additional suggestion that those rays and their absorbtion is a factor in the formation of cataract.

There is still a difference of opinion on which end of the spectrum is most malevolent to the human eye. For a review of these opinions the reader is referred to Koch, "Invisible Radiant Energy as a Cause of Cataract," American Journal of Optometry, June, 1930. Sheard[2] has reported in this publication the result of experiments on the influence of selected bands of the spectrum on the growth of the parathyroid glands of chickens and the germination of seeds. These experiments demonstrated that the ultra-violet end of the spectrum is essential to normal physiologic growth, that infra-red alone is not sufficient for normal development. He then reviews the work of others on the protein coagulating action of ultra-violet, the probable etiology of infra-red rays in glass blowers cataract and he states that while infra-red is undoubtedly responsible it is not known if the cataract is due to the absorbtion of heat and the attendant chemical change or if it is due to the nutritional and circulatory changes induced by the infra-red rays. A natural conclusion from the literature available on the subject is that of the two ends of the spectrum, the infra-red end is responsible for permanent injuries. Clinical evidence points to that conclusion by reason of cases of occupational cataracts and the fact that ultra-violet injuries are always superficial, generally conjunctivitis. Obviously the effect of normal exposures of infra-red on cataract can only be theoretic, but fluorescence of the crystalline also occurs only on exposure to unusual dosages of ultra-violet.

It is well known that to produce a comparatively deep penetration

of ultra-violet rays with a mercury water cooled ultra-violet ray generator, it is necessary to use compression. The exclusion of blood from the tissues permits a more pronounced erythema. Apparently ultra-violet is stopped by blood. Possibly other fluids of the eye have a similar effect. Certainly glass intercepts all but the longer wavelenghts of ultra-violet, and these longer wavelenghts have been pronounced harmless by Trümpy, who claims that the superficial conjunctivitis of ultra-violet exposure is caused by rays shorter than 314 μ.

The greater energy and penetration of infra-red rays, however together with the scanty evidence available should direct our attention to the infra-red end of the spectrum.

Mention should be made of the work of Ryer and Hotaling[3] on Calobar lens therapy of cataract. A tabulation of 100 cases reported by these investigators, as having worn red-free corrections for varying periods, shows that 52% of cases remained unchanged, 30.5% were improved and 17.5% had worse visual acuity despite the red free therapy. This percentage is too close to even probability to be definitely conclusive as cataract is so often a disease of extremely slow progress. But nevertheless there appears to be some, even if slight, evidence that red-free glass is therapeutically desirable in cataract.

While not losing sight of the protein metabolism factor in cataract, it is interesting to speculate on how many cases, constant wearers of red-free glass, will develop cataract as compared to constant wearers of clear ophthalmic glass. In a thorough study of this kind over many years, the infra-red factor should be definitely proven or disproven. To sum up what is known, of late years the theory has been advanced that infra-red rays are injurious to the eyes, and probably an important cause of cataract, at least in occupational types such as "glass blowers cataract." Whether the same thing is true in the cataract of old age is not so clear. The writer does not dispute the theory, merely stating that if it is true or if there is some truth in it, heat absorbing lenses for constant wear may be advantageous.

One reason why red-free lenses have not been used extensively is the dark green color and the attendant change in color values. A further annoyance is that in the shades recommended, visible light transmission is low and cases requiring such lenses are unable to adjust themselves to the reduced intensity of illumination, with the result that visual acuity already none too good is further lowered by the light intercepting characteristics of the glass employed. The change in color values is noticeable even in the lighter shades of green such as Calobar B. Reds are darkened and greens enhanced, other colors are changed in proportion to the absorbtion.

The writer takes issue with the claims of manufacturers of tinted lenses that a reduction of light intensity is desirable or beneficial. That statement is unsupported by any scientific evidence.

Let us take a camera with an "iris" diaphragm. The film or sensitive plate reacts properly only within certain limits of light intensity. If the intensity is excessive we reduce the size of the apperture or increase it if the intensity is low. The use of filters is only to gain certain effects not available otherwise with the film used. The fact that the filter necessitates an increase in exposure or apperture is an unavoidable disadvantage. The human eye is superior to the camera in that the pupil (apperture) automatically adjusts itself to varying intensities of light, therefore if a tinted lens (nothing but a filter) is placed before the eye, it is immaterial in the normal person if the transmission is 85, 90 or 95%. The iris will take care of the difference. Yet in certain cases a high transmission is preferable, for the following reasons:

1. Except on bright days and outdoors, illumination is generally deficient.

2. Dilatation of the pupil increases abberation, hence reduces acuity.

3. In presbyopes and certain types of cataract, both of the above reasons assume greater importance.

In addition it seems that the function of color vision should not be interfered with and the use of colored lenses merely produces a relative color blindness the degree of which depends on the shade used. The statement is often made that lightly tinted lenses reduce glare and that visual acuity is improved.

In discussing the effect of tinted lenses on glare, writers often make the error of describing glare as an excessive illumination or an excess of light.

Glare is a product of contrast on a glazed surface when referring to specular reflection, or excessive contrast of light and darkness. A tinted lens reduces the intensity of a focus of reflection, or of a source of light, but it correspondingly reduces the intensity of the contrasting area so that the light contrast difference between them remains the same. Therefore tinted lenses do not reduce glare, they merely reduce illumination.

Dr. Neumueller[4] reports experiments made with popular tinted lenses and their effect on visual acuity. Incidentally, he says that subjects when asked about the relative pleasantness of tints all agreed that amber was the most objectionable and green the most pleasant. Neutral shade did not present enough contrast to permit judgment. His conclusions are here quoted: "Light and medium shades of commercial absorption lenses can be worn by the average patient without marked effect upon visual acuity. The selection of these lenses can therefore only be based on their physiological advantages derived from their absorption in the ultra-violet and in the infra-red regions (of the spectrum)."

Question in meeting to Dr. Neumueller: "How do you reconcile your findings in the light tints with the fact that many of our

patients report that when we add to their distance correction a number one or two Softlite or Cruxite lens, that they see clearer, yet all your diagrams show that visual acuity lessens?"

Answer; by Dr. Neumueller: "Not all subjects have reported less visual acuity with absorbtion lenses. About half the subjects reported better visual acuity under tests. In all cases except with deep shades, changes in visual acuity were so small as to fall within the error zone of the test." Dr. Neumueller's graphs show that in the darker shade of tinted lenses there was a decided loss of visual acuity.

An ophthalmic lens, if tinted it must be, should therefore answer to the following requirements:

1. Block out undesirable radiations as much as possible.
2. Transmit as much visible light as possible.
3. Transmit all colors of the visible spectrum as evenly as possible so that color values will remain unchanged.

These requirements may seem contradictory, but when we consider that in view of our present knowledge of the subject, no desirable end is achieved by blocking out certain regions of the spectrum, we are forced to the conclusion that no ophthalmic tinted lens in common use today can claim scientific justification and at the same time meet, even in part, the requirements enumerated above.

Some time ago we received a sample of glass, of pale watery color. It was claimed to be an efficient absorber of heat, and we were asked to make tests. The first impression was that if this glass did absorb heat, its color would not be as objectionable as other lenses of that type. When surfaced down to a plane, it became obvious that relative color transmission was good from the subjective point of view. This was later substantiated in tests made at the University of Minnesota.

The first tests made were for light and heat absorbtion in comparison with other lenses, by means of thermometer and foot candle meter. Our figures on heat absorbtion were too generous due to the crudity of the apparatus and the method used. On the other hand our figures on light transmission were too conservative. The principle idea was to compare this lens with other tinted lenses in current use. It was found then and later confirmed that this new glass did have certain definite advantages. The aid of the Department of Physics of the University of Minnesota was enlisted through Dr. Valasek who assigned the work to Mr. Irving Bergeson.

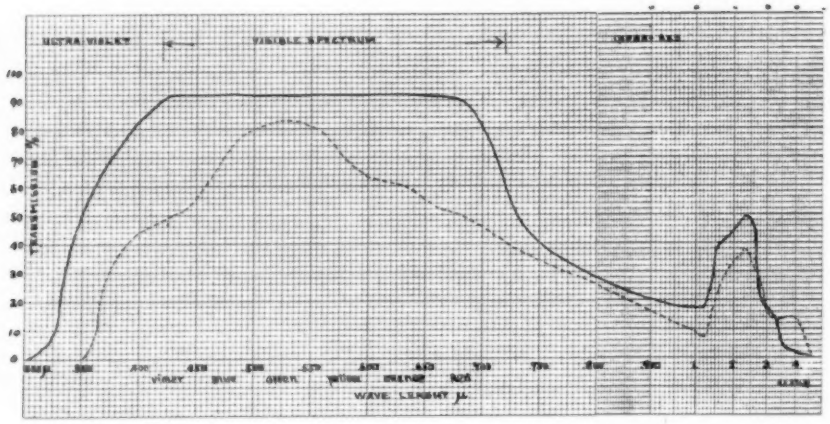
Mr. Bergeson made a spectrographic analysis of this new glass as well as a sample of Calobar B, both being of equal spectacle thickness. His report is here reproduced in full.

"The method used and the results obtained in determining the heat energy transmission coeffcient and the visible energy transmission coefficient of a sample of Calobar "B" glass and a sample of unknown glass were as follows:

"Graphs of the wavelength transmission coefficients in the ultra-violet and infra-red for the samples were used as provided. A graph of the wavelength transmission coefficients of the samples in the visible region was made using a Hilger Spectrophotometer. These graphs read percentage transmissions directly along the ordinate; the wavelength in microns and milli-microns being plotted on the abscissa. Since the transmission coefficient in the visible region was determined by use of the formula

$$I = I^{o} \cos_{2} \Theta$$

where Θ is the angle of rotation of the nicol prisms the limits of accuracy are slightly increased between 90% and 100%. Thus slight variations of transmission between these two values would be undetectable. However, these variations would create a negligible difference in the final results.



"The energy transmission coefficients were now determined by use of the formulas;

where T heat & T light = energy transmission coefficients

$E\lambda$ = energy emitted from standard source per wavelength.

$T\lambda$ = wavelength transmission coefficient.

$V\lambda$ = visibility coefficient of the eye per wavelength.

"The integration was performed by summation using a Planckian distribution of energy from a source at 5000°K. This source is considered standard and is comparable to sunlight. Due to the rapid changes of the integrand in the ultra-violet and visible regions $d\lambda$ was taken as 10 π. In the infra-red $d\lambda$ was taken as 100 π.

"This process produced the following results:

Unknown sample:

T heat = .5184 or 51.84%

T light = .9167 or 91.67%

"Wavelength energy values were taken from the 'International

Critical Tables.' Wavelength visibility coefficients were taken from 'Handbook of Chemistry and Physics'—Hodgman-Lange."

American Optical Co. figures for Calobar B are Transmission light 67%, Transmission heat 39.5%.

American Optical Co. figures for Calobar B are:

Transmission light 67%
Transmission heat 39.5%

The graphs refered to above, graphs of the infra-red and ultra-violet regions, had previously been made by the American Optical Co. The infra-red graphs showed the new glass to absorb somewhat less infra-red than Calobar B. But it did not show its performance in the visible spectrum of in the near infra-red between 700 and 900.

The findings of Mr. Bergeson were combined with those of the American Optical Co. to produce the graph shown in the figure.

The ordinate represents percentage of transmission. The abcissa the wavelengths in Microns. The scale from .300 to .900 μ is of equal parts. From .900 to 4.5 μ a semi-logarithm scale is used to conserve space. serve space.

The top curve represents transmission of the new glass, the lower dotted curve, that of Calobar B.

Examination reveals that in the infra-red region both samples absorb similar amount of energy and are closely parallel. In the ultra violet, the new glass absorbs less than Calobar, and transmits rays as short as .300 μ.

More important is the fact that in the visible spectrum, the transmission is high and uniform. This uniformity of transmission means that color values remain practically unchanged. True the lens has a bluish-green tinge. Yet when the edges of the lens are covered, little color is discernible. In the far red region transmission by the new glass drops rapidly to 50% at .760. Actually there was a slight variation in the readings of the new glass in the visible spectrum, but the variation being smaller than the spectroscope allows reading accurately, it was graphed as a straight line. The variation is less than 2%, limit of accuracy on the sine scale of the spectroscope, as stated by Mr. Bergeson in his report.

In conclusion it can be said that in view of prevalent opinion that infra-red rays are probably the only ones that might actually be injurious to the inner eye, although the manner and extent of injury is still a moot point, that this new glass may prove of desirable use as ophthalmic glass for the following reasons:

1. Its transmission curve is even for all colors except the far red, thus producing a minimum change of color values.
2. It has a high transmission co-efficient in the visible range of the spectrum, 91.67% of visible light being transmitted.

3. It absorbs 48.16% of radiant energy mostly in the infra-red regions, thus protecting the inner eye from the deleterious effect of these rays.

DR. G. L. DUPLESSIS
1406 W. LAKE ST.
MINNEAPOLIS, MINN.

REFERENCES

1. Mindt, Walter. Report on the latest ultra-red and ultra-violet researches on human and animal eyes. Proceedings of the International Optical Congress, Cologne, July, 1928.
2. Sheard, Charles. Some physical properties of the biological effects of the radiations of the electro-magnetic spectrum. American Journal of Optometry, March, 1934.
3. Ryer, E. LeRoy & Hotaling, Elmer E. Report: Red free glass in certain Cataract cases. American Journal of Optometry, May, 1935.
4. Neumueller, Julius. Variations in visual acuity with various absorbtion lenses. American Journal of Optometry. February, 1936.

THE USE OF BINOCULAR ADDITIONS FOR EXOTROPES: A CASE REPORT*

Deryck Humphries
Bedford, England

Mr. W. Age 22. Consulted me on August 6th, 1937, with regard to the removal of his squint. Refractive condition:

R —0.50 sph. ⌒ —1.00 cyl. axis 10. 6/6
L —3.00 sph. ⌒ —0.75 cyl. axis 170. 6/6

Alternating divergent strabismus, fixing with right eye for distance and left for near. Never worn glasses before (refused to wear them at school). Mentally, he was decidedly dull and apathetic about the squint. His girl, however, wanted the squint removed and saw that he did his exercises.

The angle of squint was a full 30°. At first there was complete alternation. When using one eye he could only just see a very bright light directed into the other. Convergence did not increase with accommodation.

Exercises were commenced on September 17th. I gave him the Remy separator for inducing simultaneous vision, and the "snap" game on the Pigeon-Cantonnet stereoscope.

October 1st. Could see both Remy cards, and obtain ON NE with the synoptiscope.

October 15th. After much concentrated effort, convergence was obtained by mental effort and ONE fused at a position of 20° divergence. Fusion exercises with the Pigeon-Cantonnet stereoscope produced more convergence.

October 29th. Could fuse at any distance. Binocular convergence to 8 inches. When he fused on the distance chart I discovered to my dismay that his binocular visual acuity fell to less than 6/60, and that —3.00 sph. improved it only to 6/36. I gave him abduction exercises and instructed him to attempt to see detail when fusing on smaller objects.

November 5th. Used hand diploscope. Could see DG. After 15 minutes' practice could obtain DOG with the O very blurred. Measured his binocular V.A. immediately and found it to be 6/24. This was improved to 6/9 with —1.50 sph. before each eye. This was added to his

*Dioptric Review. March 1938.

prescription and given for constant wear. I was rather doubtful about the advisability of this, but felt that his poor binocular V.A. was due to accommodating, and that if the convergence-accommodation link could be strengthened matters would improve. This proved to be so.

November 19th. Reported comfort with the new prescription, but found the prescription better for reading. Binocular vision with old prescription 6/12. Obtained DOG on the diploscope.

December 3rd. Reported quite comfortable with both pairs. During the previous four weeks he had been endeavoring under my instructions to use both eyes together and avoid letting one eye deviate. His binocular vision was now as comfortable as the monocular vision.

December 17th. (three days before date of this letter) —0.50 sph. added binocularly to his original prescription, giving 6/6 binocularly with comfort. Adduction 20 degrees to break point. With the Needle Test he obtained physiological diplopia of either needle. Was unable to squint even if he tried to.

The successful production of convergence in this case may be largely attributed to two factors. (1) the persistent nagging of the young lady who saw that the home training was carried out, and (2) an article in the AMERICAN JOURNAL OF OPTOMETRY discussing the use of binocular minus additions for exophores and exotropes in the interests of binocular vision.

It may be mentioned in conclusion that this case was one in which the patient's Approved Society offered to pay a fee for the removal of the squint by orthoptic training.

DERYCK HUMPHRIES
15 HIGH STREET
BEDFORD, ENGLAND

SOME OF THE TEACHINGS OF THE OPTOMETRIC EXTENSION PROGRAM QUESTIONED*

James O. Baxter, Jr., Opt.D.
Fayetteville, N. C.

The optometrist is generally assumed to have a trained mind and more or less of a scientific bent, since the nature of his work is such that these are considered to be essential. One would naturally conclude, therefore, that before accepting any single statement of alleged fact as resulting from ophthalmic investigation that such a one would demand at least a degree of casual substantiation of such statement. This to say nothing of a whole involved system of such interrelated statements. Present and recent developments do not tend to bear out such a conclusion.

This writer has searched in vain for the basis of many teachings now offered in the Optometric Extension Program (hereafter to be known as the O.E.P.). A typical search was for the reasoning back of and supporting the teaching that a case was "toxic" when and if the static retinoscope findings were less than was indicated by the subjective refraction. (Dr. J. O. Baxter, Sr., of New Bern, N. C., questioned this several years ago.) The response to this valid and legitimate inquiry was characteristic of the Russian secret police. He was denounced in no uncertain terms for daring to question the omniscience of the Messiah; there was some talk of offering him as a blood-sacrifice to Kali, but this scheme was abandoned for one marked by pompous silence. But to the point: from what source did this bit of nonsense derive? Insofar as this writer is able to determine, it was drawn from thin air. The process resembles the Hindu rope trick, done in reverse. However entertaining such devices may be, there seems to be no reasonable excuse for including them in a body of teachings being offered to a group of supposedly intelligent men.

We became interested in the reasoning back of the so-called Javal's Rule in 1929 and placed the matter squarely before Dr. Julius Neumueller (then faculty member of The Penn State College of Optometry), together with facts that tended to disprove the entire thing. To make a long story short, Dr. Neumueller brought overwhelming mathematical evidence to bear which thoroughly disproved the Rule, once and for all

*Submitted for publication May 20, 1938.

time. This evidence was published in the April, 1930 issue of THE AMERICAN JOURNAL OF OPTOMETRY, and was so overwhelming and conclusive that it has never been questioned. Again to the point: barring some recent change in the routine of the O.E.P., this Javal's Rule is still being taught as gospel. True, it is easier to learn and remember than the accurate tables and calculations; is that the method back of this unscientific scheme of so-called post-graduate education? A fact is a fact, regardless of whether it be sugar-coated for ease of assimilation or not. So the matter resolves itself into a question of whether or not we want the truth.

This could go on indefinitely. What merit, for instance, in the substitution of the quantitative and scientifically acceptable method of dynamic retinoscopy of Tait's by the unscientific, qualitative and uncertain method of the O.E.P.? This latter method recognizes, indeed, that a high exophoria at a reading point will probably necessitate a greater deduction from the approximate findings, but fails to state or explain how this near exophoria is to be interpreted in terms of the distance phoria, without which there can be no analysis made. The near phoria, standing alone, is termed a "physiologic exophoria" when in fact it is no such thing. A true physiologic exophoria is an indication of the tendency of a pair of eyes to deviate outward at a near point (13") *as compared to a distance* (20'). For example, if a pair of eyes present 10△ of exo at 20' and 4△ of exo at 13", the condition would be a physiologic *esophoria* of 6△.

Static retinoscopic findings would be no possible value of the working distance were unknown—that is, if they could not be *accurately interpreted*. Surely this is clear. Then for exactly the same reason, dynamic retinoscopic findings are of no particular significance if there is no method used to ascertain the exact deduction. They would be of academic interest, true enough, but we are now dealing with what is supposed to be a practical clinical procedure. Will some disciple of this program kindly step forward and explain *why* such antiquated, inaccurate and obviously uncertain methods are being advocated and taught?

Another item that invites my scrutiny in this system, as it has of others, is the rigid table of "expected" findings. A stock response to the challenge that these "expecteds" are arrived at by the rankest sort of empiricism is that "the physician has a standard table of "expected" blood-pressures, weights, blood-counts, et cetera." If physicians in general diagnosed their cases upon the slightest variation from these norms, *as is advocated by the extensioneers*, there would be an analogy. As it stands, there is none. An intelligent physician knows that there will be a considerable variation in blood-pressure, for example, in various normal individuals of the same age, and in the same normal individual from day to day and under various conditions. This is even more true of phorias, ductions and the various amplitudes. Hence I am fascinated by the small item of "½ exo (expected) induced phoria" at a distance, particularly

since I find that there is just about that amount of play, or lost motion in my own pair of Risley prisms. A more unscientific conclusion than this would simply defy the imagination.

Several persons have objected to the airing of this state of affairs on the ground that it is not "constructive." Personally, I regard it as just as constructive as, and in the same sense as the preliminary clearing and leveling of ground preceding the erection of a building is constructive. Were this not done, the resultant edifice would be ungainly and stand awry. We might even compare it to clearing a house of accumulated rubbish before renovating it. Upon which it might be added that if the optometric house does not need airing at this time with regard to this "educational" activity, one shudders to think of conditions that would justify such an airing.

I challenge the sincerity of the actual sellers of the O.E.P. If they were sincere they would admit and correct the demonstrated errors that they persist in offering the profession. I challenge the inherent truth of the entire basic structure of the Optometric Extension Program. The most casual analysis of it by an unbiased authority serves to establish the fact that it is not based in fact or founded upon accurate observation. I beg those who have unwittingly become foils and confederates of this program to stand again as men, to refuse to accept this arrant twaddle as fact, as becomes the optometric scientist.

One of Dostoevsky's characters in "The Possessed" makes the following statements:

"Shigalov is a man of genius . . . he has discovered 'equality'! All are slaves and equal in their slavery. *A high level of education and science is only possible for great intellects, and they are not wanted.*" (This writer's italics.)

"They will be banished or put to death. Cicero will have his tongue cut out. Copernicus will have his eyes put out. Shakespeare will be stoned. Slaves are bound to be equal. In the herd there is bound to be equality.

Without too much groping, I can see a perfect analogy in those remarks, having to do with the present optometric dictatorship. They describe Russian policy today. They indict all dictatorships. The character Shigalov was a madman, but we live to see his fiction come true. Have we the courage to think and act as men and scientists—to throw off the meshes of tyranny that threatens to envelope us? I ask it prayerfully.

DR. JAMES O. BAXTER, JR.
HUSKE BLDG.
FAYETTEVILLE, N. C.

AMERICAN JOURNAL OF OPTOMETRY

Vol. 15 JUNE, 1938 No. 6

EDITORS

DR. CAREL C. KOCH
1501 Foshay Tower
821 Marquette Avenue
Minneapolis, Minn.

DR. JACK I. KURTZ
1501 Foshay Tower
821 Marquette Avenue
Minneapolis, Minn.

Original papers, scientific communications, clinical reports, society proceedings, books for review, and correspondence should be sent to the Editor, Dr. Carel C. Koch.

Annual Subscription, $4.00 in Advance; Canada $4.50, Foreign $5.00.
Single Copies, 50c.

Copy of advertisements must be sent in by the tenth of the month preceding their appearance. Subscriptions, applications for single copies, communications with reference to advertising or other business should be addressed to the Business Manager, Dr. Jack I. Kurtz, 1501 Foshay Tower, Minneapolis, Minn.

Published Monthly by the
American Journal of Optometry Publishing Association.

The Journal has no objection to the reprinting by other magazines of any of its articles, provided such reprints are properly credited to the American Journal of Optometry.

NOTES ON ORTHOPTIC TREATMENT WORK

In this paper I am taking it for granted that my readers are familiar with the technique of testing accommodative-convergence relationships. So much has been written on this subject that every optometrist is familiar with the various tests employed. In this paper I will confine myself to several practical points in the management of difficult orthoptic cases, as I have worked these out in my own practice. Very little of that which will follow is to be found in text books or periodicals.

The first and most important part about orthoptic treatment work is the selection of cases. I believe that a much larger percentage of muscular imbalance cases, particularly of a higher degree than has been claimed by authorities in the past, will yield to orthoptic treatment. For instance, Savage claims that "in high degrees of intrinsic exophoria, non-operative measures will be productive of but little and that will be slow of accomplishment. Exophoria in the distance of 4△ or more and an exophoria in the near equal to the angle of convergence at that point, gives but little promise of yielding to non-operative means. An exophoria that gives diplopia in the distance under the red glass test, is practically always a case for surgical treatment." Yet many optometrists using

modern methods in administering orthoptic treatments find accommodative-convergence abnormalities of the degree mentioned by Dr. Savage and even of a much greater degree, yield to the proper non-operative orthoptic treatment. I have found this repeatedly to be a fact. The following case may illustrate this point: Miss E., age 13, high school student whose refractive error was:

O.D. - 1.00 D. Sph. ⌒ - 1.00 D. Cyl. Axis 25
O.S. -1.50 D. Sph. ⌒ - 1.50 D. Cyl. Axis 160

She showed 22△ exophoria at distance and 38△ exophoria at near. The red glass test produced diplopia and it required 14△ base in, to establish binocular vision. After 104 treatments the exophoria at distance and near completely disappeared and an adduction of 60 P.D. had been built up. This took just one year. She has since been re-examined, and showed perfect orthophoria at distance and near and still maintains the same degree of adduction. I have several similar cases on record. It is my firm conviction that any case of accommodative-convergence imbalance, comes within the scope of the optometrist, and should not be regarded as hopeless, because of the early teachings that such cases are incurable by non-operative measures. We can never hope to get results unless we try, and try not only for a few treatments but for a long period of time. Here, again, I disagree with Savage who claims that all cases, not showing a good result from treatment after a reasonable time should be operated upon. I have found, some cases which will show no improvement at all under orthoptic treatment, for a considerable time, and when improvement once starts it does come rapidly. In selecting your cases for orthoptic treatment, one must make certain that there are no ocular pathological conditions and focal infections present. It is not advisable to start treatment on patients who are extremely anemic, unless you work in cooperation with your patient's physician. The question is often asked, what type of muscular cases yield to orthoptic treatment? Here, again, we will find a great divergence of opinion. Some authorities claim that only cases of exophoria and weak adduction, will yield and that no treatments for exophoria where the ductions are normal, should be undertaken. My answer to this is that all forms of muscular imbalance will benefit from orthoptic treatment to some degree, (with the exception of a few which may be the result of some pathologic systematic disturbance). The degree of improvement will be in proportion to the amount of time and effort put in by the optometrist and the patient. The confidence and cooperation of the latter is a very important and determining factor.

After you have selected the case for treatment you will find that your patient will be anxious from the very beginning about the results he can expect and may even want you to guarantee the results. Here is where you as a professional man must be very careful. Personally I do not promise anything other than the fact that I will do all that I can to help. I always suggest telling the patient that in order to get the

best results, it is highly important that you have his cooperation and that your instructions must be followed out. Make it plain that you will discontinue treatments as soon as you note a lack of cooperation or any signs of indifference on the part of the patient. Be frank. If after treating the case for a certain length of time, there is absolutely no chance of getting any improvement, tell that to the patient. He will respect you for your honesty and sincerity. However do not be too much in a hurry to take this step. Take plenty of time before you decide to give up. You owe this to the patient as well as to yourself. In cases of this kind make a fair charge for your time and material used and most people, you will find, are reasonable and are willing to pay you well for your trouble.

I have received any number of letters from optometrists, interested in orthoptic treatment work, asking this question: "What is the percentage of treatment cases in which you get satisfactory results?" I find the results to be satisfactory in from 60 to 75% of the cases. However, the figures will be somewhat modified according to what results one considers satisfactory. Personally, I divide the cases into three classes:

1. Cases in which the results are satisfactory to the operator and not to the patient.
2. Cases where the results are satisfactory to the patient and not to the operator.
3. Cases in which results are satisfactory both to the patient and to the operator.

Now let us analyze these three classes of cases. In the first class I place the cases which show good results after being treated for some time. For instance, a marked exophoria has considerably diminished or entirely disappeared; the adduction may have been built up from a very low to a high degree. You can turn to your treatment record and note a gradual and constant improvement from day to day. You are satisfied that you have accomplished what you set out to do. This was to remove the abnormality. Yet, your patient may still complain about having the same troublesome symptoms after the treatments as he did before. He certainly is not satisfied with the results, even though you may be satisfied from what your record shows. The explanation that can be given is that there may be some other sources of trouble other than ocular which make the patient feel uncomfortable. For your own good, it is therefore advisable that when you accept one of those difficult cases for treatment to make this statement: that you do all that you can to remove the ocular abnormality and that he should be relieved of his symptoms if there is nothing else the matter with him.

In the second class, I said the results may be satisfactory from the patient's standpoint, and not from the optometrist's. This would be just the opposite of the condition outlined just before. Your patient may be noticing a gradual improvement and even be completely relieved of the

symptoms and yet your treatment record will show little or no change in the basic findings. This case will illustrate the point. Mrs. R., age 36, complained of frontal, temporal and occipital headaches. Was getting dizzy spells and at times would collapse as a result of these spells. Was very nervous and irritable. She was under medical care for some time without getting relief. Had 4△ exophoria at distance and 10△ at near. Very low duction power varying from 4 P.D. to 8 P.D. Positive reserve convergence was also very low. After treating this case for two months, the patient claimed to note some improvement and at the end of five months the patient claimed to be relieved of all the symptoms she complained of at first. The adduction at this time was only 16 P. D. and could not be raised any higher and the positive reserve convergence was only 14 P.D. To be sure, these results, as far as my record would show, are far from satisfactory. Yet the patient is completely relieved from all her former troubles. You may ask how you account for these results. It may be difficult to give a satisfactory explanation from the technical optometric standpoint, but an explanation may be had if we look at these cases from a psychological standpoint. Dr. Boris Sidis of Harvard University, claims that each of us possess a stored-up fund of energy of which we do not ordinarily make use but which we could be trained to use habitually to our great advantage. Dr. Sidis claims that it is by arousing this potential energy that the patient gets relief. The "reserve energy supply" is my reply to your question. And right here I want to emphasize the importance of the knowledge and application of psychology in our every day practice. Psychology properly applied will sometimes bring better results than any method of orthoptic treatment in existence to date. Coming back however, to the second class of cases: If your patient tells you that he notices considerable improvement, even if you do not find any change in the condition, do not argue this point. Just carry on your work as before and let the patient continue to feel still greater improvement as he most likely will, because you must have tapped one of the sources of "reserve energy."

In the third class of cases where both the patient and the operator note that results are satisfactory need no further comment.

Any one practicing extensively in the field of orthoptics knows that for some of the difficult and stubborn cases it takes a long time to get satisfactory results. People as a rule are impatient and in a hurry and some will discontinue coming for treatment after a short period of time if some results are not noticed. How to hold these patients, is the question many optometrists are confronted with. These suggestions may help you hold some of your cases:

(a) Keep your patient informed as to what you are doing and what you anticipate to accomplish and keep him informed of any improvement you may notice.
(b) Create in him a desire to accomplish the things he cannot do now.

(c) Keep him interested in the work. It becomes monotonous for a person to have to do the same thing over and over again every day in the very same way.

You cannot expect to hold an orthoptic case for any length of time by merely doing the same thing every day. You must develop individual treatment technic and vary it from time to time to hold the patient's interest.

It is very important that a complete record of your orthoptic techniques and findings be kept. I do not know of an entirely satisfactory treatment record card at the present time. I am using one which is made up of a standard size sheet 8½ by 11 inches. There is a space provided at the top for the name, address and case number. The first and last divisions are used for recording consecutively the findings "Before treatment" and "After treatments." Under the main headings "before treatment" are to be found the subheads of tonicity, ductions and fusion faculty. Under "tonicity" space is provided to record the findings of the distance and near phoria tests. Under the "duction," space is provided to record the amount of prism base-in, out, up or down for both break and recovery. Under "fusion faculty" space is provided for recording the treatment given with the amblyoscope, stereoscope and the positive and negative reserve convergence. The same subheads appear under the main heading of "After treatments." The center division is devoted to the treatment employed on that particular visit. Under this head space is provided to note the type of treatment technique used.

One line across the page is used for each visit and from 30 to 35 treatments can be recorded on each sheet. The reverse side of the record is left blank. This provides ample space for special notations during the treatment period.

Before closing I wish to touch briefly upon these two last points:

1. How to secure these difficult cases, and
2. The fee to be charged for your service.

I consider these two points important, because you certainly cannot practice unless you have cases to work upon and if you do get such cases it is important that you get a fair professional fee for your services.

I have talked with many optometrists and a frequent question asked is "How do you get those particular cases?" My answer is that it is a matter of not knowing them when you do get them. The other day an optometrist from a neighboring state was in my office and while talking on this subject he made the remark that during the 20 years he has been in practice, he never had a case that payed him $100 to $200 for orthoptic services. I questioned his statement. How do you know he retorted? I merely asked him to answer these questions—did you ever have a case of squint? or a very high degree of esophoria or exophoria, something like 20△ to 30△? Any number of them was the reply. Did you suggest doing anything for them besides prescribing a correction?

No. Then you have had all of these cases which pay high fees and did did not recognize them. You simply let them go to some other refractionist where they were rendered necessary service and charged accordingly. When a case of this kind just mentioned comes into your office it is up to you to prescribe for them the full services which they need. Offer none but the best and arrange the fee accordingly.

In determining the fee to be charged several factors are to be taken into consideration:

(1) The type of a case you have on hand.
(2) What you contemplate doing.
(3) The patient's ability to pay.
(4) The value you place upon your services.

I find that people are willing to pay a fair fee to an optometrist just as they do to a dentist or surgeon. I also find from experience that I get a great deal more cooperation from a case which pays me a $300 fee than from one which pays only a $25 or a $50 fee because that one that pays $300 has an important financial interest in the orthoptic treatment work then being done In considering the fee the value a person puts on his own service is of utmost importance. If we as optometrists are to be successful, we will have to charge for what we know, and no one knows more as to what your service is worth than you do yourself.

J. I. KURTZ

* * * * *

SPECIAL REPORTS

THE EYE, THE WORK AND LIGHTING: A VISUAL TRIANGLE*

A. S. Lidiard, F. I. O.

In every visual task there are three essential factors, the eye that sees, the thing that is seen, and the light by virtue of which it is seen—or in some instances the light which hinders seeing.

For vision to be at its best, easy, accurate and speedy, all these factors must be favorable. In normal vision the ocular adjustments are not the finely accurate ones of which the eyes are capable, they are only coarse and approximate. In ordinary reading, when conditions are favorable, i. e. good eyes, easy co-ordination, good print, good lighting, we look along the line in series of hops; we do not fix each letter nor even each word.

If any of the conditions are unfavorable, if there are refractive or muscular errors, poor print, unsuitable lighting (insufficient, or glaring,

*An abridgement of the material in the Refractionist, Jan. 16, 1938.

or unsteady), then vision is less easy. The eyes try to compensate for the bad conditions by more accurate accommodation, more precise fixation, shorter hops and more fixations in a line of type; they are stimulated to try slight changes in adjustment by which perception may be aided. Vision is slowed, there is strain in the co-ordinating centres and in the ocular muscles themselves. Frequently there is mental strain also.

Since any of these factors—the eye, the task, lighting—may cause visual discomfort, all of them come within the refractionist's sphere to consider and, if possible, to rectify in the endeavor to give comfort to his patients.

Principally and pre-eminently the optometrist's work is concerned with the eye itself, its correction by means of lenses and, where the binocular organ is defective, with orthoptic treatment or the prescription of prisms. In the majority of cases these means enable us to give increased comfort and ease of vision. Some can be further assisted by attention to the other two corners of the triangle, and there is an increasing number of cases whom we cannot make comfortable without this attention.

The visibility of an object depends upon a number of factors, the principle being

Size of object, or of its critical detail.
Contrast in brightness between object and background.
Brightness of object.

Both contrast and brightness are important since, within limits, inadequacy in one respect may be offset by an increase in the others. An object cannot be seen unless its brightness differs from that of its background; a perfectly black object on a perfectly black background would have no contrast and would be invisible; a perfectly black object on a perfectly white background would have a contrast of 100 per cent. Good black print on a good white paper has a contrast of about 90 per cent. In dark needlework the contrast may be lower than 10 per cent. Small wonder our women patients complain that dark work troubles them.

By attention to contrast we can sometimes exercise considerable influence on visibility. As an example of reduction of visibility we may cite the use of camouflage in war time, with the effect of making large objects of very definite outline almost invisible at short distances. On the other hand visibility can often be increased by choice of a suitable background. Consider how much easier a needle is to thread when placed against something white, and how much better a light colored silk stocking may be darned over a black "mushroom" than over the usual light one. Woll recorded a case some years ago where he was called in to advise in a textile mill where there had been constant complaints of eyestrain and bad work. At one stage in the process he found that the operators were using a black thread on a dark material, presenting a very low contrast. On his advice a red thread was substituted for

the black, with a marked reduction in complaints.

In this case the red thread did not show in the finished product, so that the change was possible. Frequently, of course, the contrast is fixed by the character of the work; then if visibility is low it can be increased by greater brightness, i. e., by providing more light on the work. We shall refer to this later.

With three-dimensional objects, however, we have often a further means of increasing contrast, by adjusting the distribution of the lighting so as to increase visibility by means of shadows and highlights.

We see two-dimensional objects almost entirely through the brightness contrast between them and their background. With three-dimensional objects there are additional factors which contribute to visibility. The shadow on an object, by its outline and its gradation from light to dark, gives much information as to the form of the object. Consider the difference in appearance between a matt surfaced cylinder and a similar plane rectangle each illuminated obliquely from the side so that the cylinder has a shadow, increasing in depth, on the side more remote from the light source, while the rectangle has no such shadow. The difference between the two forms is immediately evident. If, however, the two objects are illuminated from straight in front, in the direction of the observer, there will be no shadow on the cylinder and the two forms will be much less easy to distinguish. In the case of objects with a polished surface information of their form is given by high-lights or specular reflections, as well as by shadow.

Directional lighting serves to create contrast in a great variety of operations from domestic tasks like needle work to industrial tasks as diversified as engraving, typesetting, inspection of machine parts, tailoring, confectionery making.

In examining a shell or metal frame for polish, for finish of joints and quality of pinning, the optician automatically turns it this way and that in order successively to get the minute shadows and then the highlights to show up any irregularities. In many tasks the nature of the work prevents it being turned in this manner. Then attention should be given to the lighting itself so that its directional qualities create contrast. In the home, particularly, an auxiliary light so placed as to shine obliquely on the work is of great assistance for needle work.

"Lighting for seeing is at its best only by accident when merely foot candles are supplied for seeing three-dimensional objects. The modelling of objects by light and shade, shadows cast upon adjacent surfaces, highlights due to specular reflection and other factors is influenced by the direction, diffusion, and distribution of light. Therefore lighting cannot generally perform its best service in seeing unless it is controlled in these important respects." (Luckiesh: Seeing, Chapter XVII.)

In other cases where contrast is low and critical vision is demanded and it is impossible to increase the contrast by special backgrounds or by

directional lighting visibility can be increased by increasing the brightness, i. e. by raising the level of illumination. Many workers have shown that increased intensity of illumination on work increases its visibility to a marked degree.

Increased illumination is particularly helpful with the elderly, whose reduced acuity is in part due to loss of transparency of the media together with a permanently reduced pupil area. We know from experience that most of our presbyopic patients needing a new correction say that they can see to read or sew by daylight, but as soon as it is time to light up they are in difficulties.

Feree and Rand have shown that the range of accommodation is greater under high illuminations than low or moderate, that critical detail can be seen not only at a greater distance under good illumination, but also at a closed point. They carried out a series of observations on two groups, one of non-presbyopes, the other of presbyopes, taking the near point under illumination of 1, 5, 25 foot candles. In every case there was an increase in the accommodative amplitude at 25 foot candles, ranging, in the non-presbiopes, from 0.3D to 2.4D with an average of 1.12D. In the presbyopic group the increase was greater, ranging from 0.6D to 4.32D with an average of 1.78D.

As was pointed out in a previous article, the mere increase of illumination intensity is not sufficient. The higher the foot candle level provided the more care must be taken in the light distribution. Good lighting needs to be sufficient, but it also needs to provide no glare or harsh contrasts, to utilize highlights and shadows when they help and to avoid them when they hinder.

Improving lighting is not a substitute for glasses, though defective eyes feel the need of and benefit more from good lighting than normal eyes. An eye which focuses with difficulty, or a pair of eyes which have difficulty in co-ordination, will experience less embarrassment under optimum conditions of illumination, but they will still need optical attention if they are to function easily.

* * * * *

BOOK NOTICES

AN INTRODUCTION TO CLINICAL PERIMETRY. H. M. Traquair, M.D., F.R.C.S. Ed. with a Foreword by Norman M. Dott, M.D., Ch.B., F.R.C.S. Ed. Published by the C. V. Mosby Company, 3525 Pine Blvd., St. Louis, Mo. 227 Illustrations. 3 colored Plates. 320 pages. $9. cloth. 1938.

The third edition of this classic on perimetry is now off the press. This work like its two previous editions will continue to enjoy all of the confidence and respect of both the optometric and ophthalmological

practitioners, inasmuch as it was originally written and since then revised to keep the practitioner informed to the fullest in this phase of diagnostic procedure so essential to all eye men. Traquair covers the subject as does no other writer and in so doing presents to the examiner a wealth of material on the subject of field charting that is very practical indeed. In only one particular is this text lacking and that is this. The fine work done by the California optometrist Brombach is nowhere mentioned, and in this particular the volume misses some of the newer diagnostic work done in field charting. With the single exception of this one omission the book is outstanding and the entire work is one which should be in the hands of every refractionist.—C. C. K.

* * * * *

PSYCHOLOGICAL OPTICS, V. W. Grant, M.A. Published by the Professional Press, Chicago, Illinois, 240 pages, 63 illustrations, cloth covers, 1938, price $4.00.

The practitioners and teachers of optometry are gradually beginning to appreciate the important part that psychology plays in the practice of optometry. Until recently some of the optometry schools devoted little time to the study of psychology, others none at all. In teaching the subject of visual psychology to optometry students one was confronted with the difficulty of having to search for this material in the books on physiology, physiological psychology, general psychology, etc., because there was no single book containing all this material between its covers. Grant, in writing the book of Psychological Optics supplied a long felt need. He succeeded in gathering together the material on visual psychology in one book. This alone will save the interested reader much time and effort, which he would otherwise have to spend searching in different fields. With this statement the reviewer does not wish to leave the impression that the book is merely made up of a collection of papers and facts which were already published elsewhere. This is far from being the case. Grant does present new factual material. His presentation is in an easy readable style. Many of the chapters are worth reading and rereading because they tend to throw much light on "the mass of darkness" which now surrounds much of the orthoptic work carried on by many practitioners, both optometric and medical as well.

The author takes particular pains to show how the conditioned reflex concept works and the importance of its application in orthoptic work.

The first part of the book deals with the basic physiologic facts relating to vision. The second part describes definite psychologic concepts such as perception of space, attention in relation to vision, visual sensations, and illusions. The last but not the least important part of the book is a large and well selected bibliography made up of some 170 different works dealing with some aspect of visual psychology. The reviewer can recommend this book as a valuable addition to the library of any optometrist. J. I. K.

"Doctor Do You Use 'Drops'?"

Every day this question is asked in your office by some patient interested in having ocular work done in the best and most satisfactory manner. These patients do not want drops—nor are they against the use of them in refractive work. What they do want is authoritative advice, and then refractive work which is done in the exact way as to give them the greatest possible eye comfort.

The question is asked, not to irritate you, nor to waste your time. It is asked because many thinking people are a little bewildered about the entire cycloplegic question and are today sincerely and honestly seeking reliabe advice.

are YOU able to give them SOUND and CONVINCING ADVICE on this question?

When asked: Do you answer the question in a manner which is both reassuring and convincing to the patient?

YOU WILL FIND THIS MUCH EASIER TO DO

if you use the newly published monograph dealing with this subject, when the matter is brought up by some patient who is sincerely seeking the true facts.

AN INVESTIGATION AS TO THE NEED FOR
"DROPS"
OR CYCLOPLEGICS IN EYE EXAMINATIONS

This new treatise was written and developed to fill just this sort of need. This new monograph covers every phase of this question giving all of the facts and all of the necessary answers, each supported by evidence which will lend conviction to your discussion of the topic.

SEE NEXT PAGE